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98.7-1



The Office of the Secretary
Federal Communications Commission
Room TW-A325,
445 12th Street SW.
Washington DC 20554

Re: Comments on IB Docket No. 02-54

Dear Sir,

MIT Lincoln Laboratory is a Federally Funded Research and Development Center (FFRDC) operated by M.I.T. in support of the Department of Defense. One of our activities pertains to Space Surveillance, *ie.*, development of techniques in detection and tracking of resident space objects and analysis of radar and optical data on these objects. This work is largely funded by AF Space Command.

Recently, we have been participating in assessing the collision probability in Geosynchronous orbits; and, in cooperation with the AFSPC and some private satellite owner/operators, in providing advance warning of close approaches in GEO. With our background and experience in this realm, we submit the following comments on the FCC IB Docket No. 02-54 "In the matter of Mitigation of Orbital Debris". Our submission is organized as a list of questions and comments with reference to particular sections in your document.

**Section II: Background:**

**Subsection B: Para 12:**

Storage orbits are a good idea and are, we suspect, unavoidable. However, it should be realized that these storage orbits might preclude future operations of satellites that may either use these orbits or transit regularly through them. For LEO satellites, it would be better to suggest a storage orbit with apogee and perigee in the 2000-3000 Km. range. This is the region of intense radiation in the Van Allen belt and it is unusual, if not unlikely, that satellites will be designed to operate in this belt. For GEO satellites, the use of geostationary orbits in the geopotential wells (105 deg. West or 75 deg. East sublongitudes) for long-term storage/disposal should be strongly discouraged.

**Section III: Discussion**

**Paragraph 28:**

It would be very useful to have some of the adopted rules, particularly with respect to disposal orbits, applied to spacecraft licensed prior to the adoption date – say back to the early 90's. This will be particularly important in geosynchronous orbits (GEO) and, as satellite lifetimes are typically >10 years, should not pose too much of a burden on satellite owners.

**A. FCC Statutory Authority....**

**Para 31:**

It is not unusual for a U.S.-licensed space station to be sold in mid-life to a non-U.S. organization. How will debris mitigation/disposal be addressed for such satellites without International agreements on these rules?

**Para 34:**

It would be beneficial to have the FCC and NOAA coordinate policies in pot mission disposal.

**B. Elements of Orbital Debris Mitigation**

**Para 38:**

It is essential that the FCC address the issue of small satellite constellations at some point. There have been, and will continue to be, experimental launches of a few small spacecraft. In general, these are limited in power and operational life. Perhaps a blanket exception could be granted to all such satellites at altitudes below 600 Km.; with more stringent requirements on satellites above these altitudes in terms of end-of-life disposal. Possible strategies are:

a) Initial perigee altitude below 600 Km. with a long-term study to ensure that the satellite decays in an acceptable time frame for low earth orbits and high eccentricity orbits.
b) Operation in disposal orbit altitudes etc.

**Para 40:**

See comment above on **Para 31.**

**Para 47:**

Our experience shows that while satellite operators are generally conscientious about staying within assigned longitude bands in GEO, inadvertent errors occur because of the following reasons:

a) Operators depend on their transponder ranging data to determine orbits and current longitude of their satellites. Unfortunately, there is no independent means of calibration of these ranging data and as a result bias errors of the order of tens of meters are common with an occasional error of the order of hundreds of meters. A 1000 meter error could result in satellite mislocation by $0.1^0$ with a 100 meter error resulting in mislocation by $0.01^0$. Since these are significant with respect to the assigned longitude band, it is important for the data to be calibrated on a regular basis – since hardware changes at ground stations do occur, calibration is **not** a one-time activity.
b) Reference systems in which satellite longitudes are determined must be consistent particularly for closely located GEO space stations.

**Para 50:**

It is the intent of this proposed rule-making to discourage parking of old space stations in GEO at the geopotential wells at $105^0$ West sublongitude and $75^0$ East sublongitudes. We strongly endorse this as the geopotential well at 105 is getting quite crowded.

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**Para 51:**

It is not uncommon to have many satellites inhabiting a finite longitude extend in GEO. For example, there are clusters from 2 – 7 satellites within $0.5^0$ longitude bands. Many of these clusters consist of satellites owned and operated by different organizations. Hence it is important for owner/operators of satellites in clusters to coordinate or at least be aware of maneuvers of nearby spacecraft so as to reduce inadvertent collision or very close approaches.

**Para 55:**

Reporting requirements for fuel reserves may not be needed if there are adequate penalties for non-compliance with disposal requirements.

Regards,

Dr. Ramaswamy Sridharan
Leader, Group 98
Lincoln Space Surveillance Complex